Claims

What is claimed is

1. An apparatus for substrate imaging, comprising:

at least one transmitter;

at least one receiver;

a controller coupled to the receiver and the transmitter wherein the controller comprises a processor and at least one substrate imaging program that when executed on the processor performs a method of;

(a) determining the trigger intervals for at least two trigger signals for the acquisition of at least two images on a substrate surface moving with non-linear motion wherein a first trigger interval corresponds to a first image position and a second trigger interval corresponds to a second image position;

(b) transmitting one or more optical signals from the transmitter to the first and second image positions on the substrate surface;

(c) receiving the at least two trigger signals at the receiver wherein the two trigger signals comprise a first trigger signal corresponding to the first trigger interval, and a second trigger signal corresponding to the second trigger interval; and

(d) receiving a portion of the one or more optical signals at the receiver from the first image position and the second image position.

2. The apparatus of claim 1, wherein the receiver comprises a time-domain integration camera, a line camera, a CCD camera, or combinations thereof.

3. The apparatus of claim 1, wherein the transmitter comprises, a broad band light source, a narrow band light source, or combinations thereof.

4. The apparatus of claim 3, wherein the light source is a halogen light source.

5. The apparatus of claim 1, wherein the first trigger interval corresponds to a first motor rotation indicative of the first image position and the second trigger interval corresponds to a second motor rotation indicative of the second image position.

6. The apparatus of claim 5, wherein the first and second motor rotations are step wise, linear or non-linear.

7. The apparatus of claim 6, wherein the first and second motor rotations are indicative of the rotation of one or more motors comprising stepper motors, linear motors, or non-linear motors.

8. The apparatus of claim 1, further comprising an interval measuring apparatus to determine the trigger intervals for the at least two trigger signals.

9. The apparatus of claim 8, wherein the interval measuring apparatus comprises counters, clocks, or any combination thereof.

10. A method of substrate imaging, comprising:

(a) determining the trigger intervals for at least two trigger signals for the acquisition of at least two images on a substrate surface moving with non-linear motion wherein a first trigger interval corresponds to a first image position and a second trigger interval corresponds to a second image position;

(b) transmitting optical signals from a transmitter to the first and second image positions on the substrate surface;

(c) receiving the at least two trigger signals at a receiver wherein the two trigger signals comprise a first trigger signal corresponding to the first image position, and a second trigger signal corresponding to the second image position;

(d) receiving a portion of the optical signals at the receiver from the first image position and the second image position;

(e) processing the optical signals into an image; and

(f) displaying the image.

11. The method of claim 10, wherein the receiver comprises a time-domain integration camera, a line camera, a CCD camera, or combinations thereof.

12. The method of claim 10, wherein determining the trigger intervals for the at least two trigger signals for the acquisition of that at least two images on a substrate surface corresponds to a first image position indicative of a first motor rotation and a second image position indicative of a second motor rotation.

13. The method of claim 12, wherein determining the trigger intervals comprises measuring the rotation of a motor.

14. The method of claim 13, wherein the rotation of the motor is step wise, linear or non-linear.

15. The apparatus of claim 13, wherein the motor comprises stepper motors, linear motors, or non-linear motors.

16. The method of claim 10, wherein the trigger intervals equal the number of steps of a stepper motor and determining the first trigger interval for the first image position and the second image position comprises:

(g) measuring a first number of steps of the stepper motor for the first trigger interval; and

(h) measuring a second number of steps of the stepper motor for the second trigger interval.

17. The method of claim 10, wherein determining the first interval for the first image position and the second interval for the second image position comprises measuring a first time interval corresponding to the first image position and a second time interval for the second image position.

18. The method of claim 17, wherein measuring the first time interval for the first image position and a second time interval for the second image position comprises:

(e) providing the step time for each step of a stepper motor;

(f) determining the number of stepper motor steps for the first image position and the number of stepper motor steps for the second image position;

(g) summing the step time for each step of the stepper motor for the first

image position; and

(h) summing the step time for each step of the stepper motor for the second image position.

19. The method of claim 18, wherein the step time is equal to the time between each step plus a dwell time for each step.

20. A method of substrate imaging, comprising:

(a) determining an interval corresponding to at least one image position defining an image on a non-linearly moving substrate surface;

(b) transmitting optical signals from a transmitter to the image position; then

(c) receiving at a first sensor of the time-domain camera a portion of the optical signals from the image position;

(d) processing the optical signals into a first image;

(e) determining an integration interval for a second sensor of the time-domain camera corresponding to the non-linear movement of the substrate surface; then

(f) receiving the optical signals at the second sensor from the image position;

(g) processing the optical signals into a second image; and

(h) integrating the first and second images.

21. The method of claim 20, wherein the step of determining the integration interval for the second sensor comprises determining the number of stepper motor steps between the first sensor and the second sensor.

22. The method of claim 21, wherein determining the number of stepper motor steps comprises counting the steps from the image position from the first sensor to the second sensor.

23. The method of claim 20, wherein the step of determining the interval corresponding to at least one image position comprises determining the rotation time of a motor wherein the rotation time defines the interval corresponding to the at least

one image position.

24. The method of claim 23, wherein the rotation time corresponds to a step-wise, linear, or non-linear rotation of the motor.

25. The method of claim 20, wherein the step of determining the interval corresponding to the at least one image position comprises measuring the rotation of a motor wherein the rotation time to achieve the rotation angle defines the interval.

26. The method of claim 25, wherein the rotation time corresponds to a step-wise, linear, or non-linear rotation of the motor.

27. The method of claim 20, wherein the step of determining the integration interval for the second sensor comprises determining the number of stepper motor steps from a start trigger point to the second sensor.

28. The method of claim 27, wherein determining the number of stepper motor steps comprises counting the steps from the start trigger point to the second sensor.

29. The method of claim 28, wherein the start trigger point is when the first sensor images the first image position.

30. The method of claim 28, wherein the start trigger point is about when a substrate imaging event begins.